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Mathematical Models to Help Understand Developmental Biology and Cancer

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Abstract

As the understanding of cellular regulatory networks grows, system dynamics and behaviors resulting from feedback effects of such systems have proven to be sufficiently complex so as to prevent intuitive understanding. Mathematical modeling in engineering and in physics or chemistry has traditionally sought to extrapolate from existing information and underlying principles to create complex descriptions of various systems, which could be analyzed or simulated, and from which further abstractions could be made. However, in studying biological systems, often only incomplete abstracted hypotheses exist to explain observed complex patterning and functions.

The challenge has become to show that enough of a network is understood to explain the behavior of the system. Mathematical modeling must simultaneously characterize the complex and nonintuitive behavior of a network, while revealing deficiencies in the model and suggesting new experimental directions. In this talk, we describe the process of modeling two biological networks: planar cell polarity in development, and treated regulatory networks in breast cancer. We demonstrate the use of the mathematical models, both in understanding the system behavior, and in suggesting new treatments.

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Keywords: Invited keynote speech; Mathematical modeling; Systems Biology; regulatory networks in breast cancer; planar cell polarity

1. Video recording of the keynote speech given by Claire Tomlin in Budapest on the 5th of may, 2011

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Bibliography

In September 1998, Claire Tomlin received her Ph.D. from the Department of Electrical Engineering and Computer Sciences at Berkeley. She received my B.A.Sc. in Electrical Engineering from the University of Waterloo, Canada, in 1992, and her M.Sc. in Electrical Engineering from Imperial College, London, England, in 1993.

Claire Tomlin's research areas cover systems science – stochastic hybrid dynamics, control; applications to systems biology (Claire Tomlin just spent 6 month sabbatical at the Karolinska Institute working with cancer researchers), avionics, flight control. Claire is a McArthur Fellow, and currently a Professor, at the Electrical Engineering and

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Reference

[1] http://www.eecs.berkeley.edu/∼tomlin/.